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ANTITORQUE TRAINING: EVALUATION OF EFFECTIVENESS IN REDUCING MI--ETC(U)

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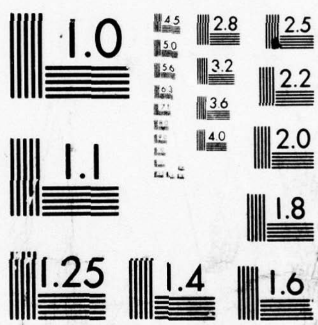

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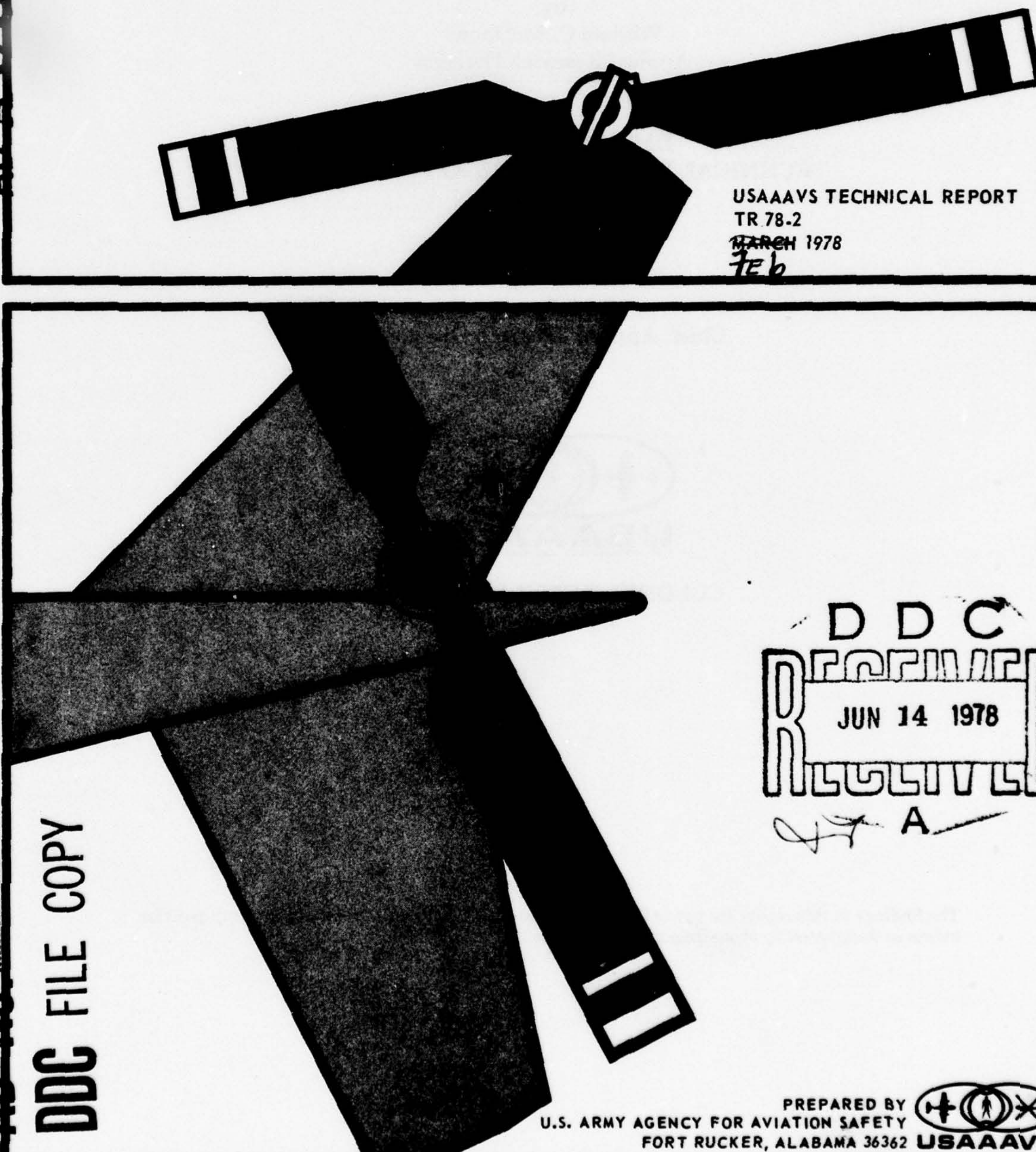

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ANTITORQUE TRAINING:
EVALUATION OF EFFECTIVENESS IN REDUCING MISHAP LOSSES

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This evaluation addressed the effectiveness of training for antitorque system malfunctions. An evaluation team composed of 11 analysts reviewed 121 mishaps meeting established criteria. Results indicated that emergency antitorque training was effective in those situations involving loss or impaired control of the antitorque system. In the case of emergency situations involving a loss of thrust or loss of component, present antitorque training appears to be less than adequate. The data supports continuation of emergency antitorque training. (cont'd)

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Results further imply that written procedures for coping with loss of thrust in the UH-1 and OH-58 should be reviewed for clarity and revised for ease of application. Further study should be conducted to determine the optimal course of action to take in the event of antitorque failure or malfunction.

SUMMARY

Introduction. Fixed-pitch antitorque training has been used to build aviator skills and confidence for all types of antitorque system malfunctions. Mishaps that occur during emergency antitorque training raises the question concerning the requirement for this training. The purpose of this study was to evaluate the effectiveness of fixed-pitch antitorque training in providing the skills and confidence to aviators required to cope with actual antitorque malfunctions. This evaluation was based solely on mishap experience.

Method. Mishap data on four types of aircraft representative of the majority of the Army's operational aircraft using antitorque systems were evaluated by a team of 11 analysts. Six hundred and ten mishaps were evaluated against established criteria to select those cases in which training was a key factor. One hundred and twenty-one mishaps met criteria *for evaluation. These mishaps* were then analyzed to determine the type of malfunction and actions taken by the crew during the emergency.

Results. The evaluation indicates that simulated antitorque training is effective in those emergency situations for which it is designed (specifically, loss or impaired control of the antitorque system). Present training is minimally effective in situations involving loss of *component or loss of thrust.*

Results further indicate a lack of clarity and ease of application in UH-1 and OH-58 procedures for coping with a loss of thrust of the antitorque/tail rotor system when contrasted with the AH-1.

Results are inconclusive concerning the best course of action in coping with antitorque failure or malfunction, i.e., continued flight versus autorotation.

Discussion and Conclusions. Simulated antitorque training should be continued. This training should be conducted only to hard surfaces or carefully selected training areas. Additionally, training procedures utilizing simulators should be instituted to provide aviators with "hands on" experience in dealing with a loss of component or loss of thrust type *malfunction.*

Procedures in the UH-1 and OH-58 for coping with a loss of thrust should be reviewed and revised. A thorough study should be conducted to determine the optimal course of action to take in the event of antitorque failure or malfunction, i.e., continued flight or autorotation.

CONTENTS

ANTITORQUE TRAINING: Evaluation Of Effectiveness In Reducing Mishap Losses

INTRODUCTION

The helicopter tail rotor/antitorque system (hereafter referred to as antitorque system) is designed to counteract the torque of the main rotor and provide directional control. In a study of UH-1/AH-1 mishaps, Knudsen and Carr (1974) reported that tail-rotor-associated accidents occurred 1.8 times more frequently than all other mishaps, regardless of the system involved. The same study reported that in the case of materiel failures, an antitorque system component failure is 2.7 times as likely to cause an accident as any other system materiel failure. These findings indicate the necessity of: (1) Providing a more reliable antitorque system and/or (2) providing training to cope with antitorque system failure or malfunction. This study focuses on the training aspects of coping with antitorque system failures or malfunctions.

Historically, fixed-pitch antitorque training has been used to build aviator skills and confidence for all types of antitorque system malfunctions. Frequently, mishaps occur during this training and the question arises as to whether the cure, i.e., simulated antitorque training, is worse than the problem, i.e., maintaining skill required in an emergency.

To minimize risks of mishaps during simulated antitorque training, the U.S. Army Aviation Center (USAAVNC) in September 1975 discontinued this training as a graded maneuver for Initial Entry Rotary Wing (IERW) classes. The maneuver was only to be demonstrated by instructor pilots. Training Circulars (TC) 1-35 and 1-36, however, required field units to grade antitorque emergency procedures on annual flight standardization checks. Consequently, field units were forced to provide initial training on the maneuver since it was not taught during IERW training. In February 1977, USAAVNC recommended revision of TC 1-35 and TC 1-36 to require antitorque training be conducted by units only as a demonstration maneuver. This revision was intended to provide consistency between IERW training and unit training requirements. However, during the coordination process of the revision to TC 1-35 and TC 1-36, several of the major commands (MACOMs) did not concur with this change. The MACOMs asserted that antitorque emergency procedure training was a valid requirement and should be reinstated as a graded maneuver for IERW students. To resolve this difference, the Deputy Chief of Staff, Operations (DCSOPS) requested USAAAVS to evaluate antitorque mishap experience.

Several issues were tested during this evaluation. First, is the fixed-pitch antitorque training effective in providing the skill and confidence to aviators required to cope with an actual emergency? Second, do the skills attained through IERW and unit antitorque training effectively transfer across different types of tail rotor antitorque system malfunctions? Third, does the mishap data show any trend that would indicate a procedure for dealing with antitorque failure which may reduce probability and severity of materiel damage, injuries, and fatalities? Fourth, is the mishap experience more disproportionate for antitorque emergency training than for other types of in-flight emergency training?

METHOD

Mishap Data. Mishap data on four types of aircraft--UH-1, AH-1/TH-1, OH-58, and OH-6--were evaluated. These aircraft were selected because they are representative of the majority of the Army's operational aircraft using antitorque systems.

The mishap data used in the evaluation covered the period 1 July 1972 to 30 September 1976 (FY 73 - FY 7T). This time period was selected because it represented the operations and setting that provoked the issue. Further, the quality of mishap data for this period had improved over earlier periods.

Evaluation Team. A team of 11 analysts of varied backgrounds, aviation experience, and expertise conducted the evaluation. This team consisted of operational pilots and instructor pilots, air safety specialists, maintenance technicians, and research psychologists.

Evaluation Criteria. To determine the effectiveness of training for antitorque system malfunctions, it was necessary to establish criteria that would eliminate instances in which the crew had no opportunity to use in-flight emergency procedures, e.g., a malfunction that occurred during runup of the aircraft. The criteria used to select mishaps for evaluation were:

1. An antitorque system malfunctioned or failed in flight.
2. The crew could have taken some emergency antitorque corrective action to minimize the severity of the mishap.
3. The crew must have experienced some impairment of antitorque system control during flight.
4. The crew must have exhibited poor techniques in performing a simulated antitorque maneuver.

Evaluation Materials. The evaluation team was furnished with mishap reports that met the above criteria. Data from mishap reports and evaluations were recorded on worksheets. A sample worksheet appears at Appendix A.

Procedure. A computer search by type aircraft within the selected time frame provided a listing of all mishaps involving any failure/malfunction/training problem associated with the antitorque system. Three members of the evaluation team reviewed each mishap to insure criteria were met. A total of 610 mishaps were reviewed, with 121 mishaps meeting criteria for the evaluation. Appendix B contains information concerning the mishaps that did or did not meet criteria for evaluation by mishap classification. Each member then evaluated mishaps meeting criteria to determine the type of malfunction of the antitorque system.

Three types of malfunctions of the antitorque system were defined:

1. Loss of component: This type of mishap results from an actual loss from the aircraft of a component of the antitorque system. In addition to control problems, this type of mishap usually results in a shift of the aircraft center of gravity.
2. Loss of thrust: This type of mishap results when the tail rotor slows or stops turning and is usually caused by a failure/malfunction in the antitorque system drive train.
3. Loss or impaired control: This type of mishap results from the complete or partial loss of control over the thrust which the tail rotor continues to produce, i.e., stuck antitorque pedals and silent chain failures. Antitorque training is usually directed toward this type of failure/malfunction.

During the evaluation, each analyst further determined if the action taken by the crew brought about a satisfactory or unsatisfactory result. Aircraft damage was deemed inappropriate to determine satisfactory or unsatisfactory termination of an emergency condition. For example, a mishap may have resulted in a great amount of damage if the emergency occurred over unsuitable terrain. However, action taken by the crew may have minimized probability of injuries or fatalities. Each mishap was evaluated and categorized as:

1. Satisfactory result: Judgment made by the analyst(s) that the action taken by the crew in response to the emergency reduced aircraft damage and/or personnel injury in the specific mishap situation.
2. Unsatisfactory result: Judgment made by the analyst(s) that materiel damage, injuries, and fatalities had not been minimized by the action of the crew in the specific mishap situation.

Upon completion of the evaluation, data were subjected to statistical analyses using the Chi

Square (X^2) test as described in Siegal (1956). In instances where the population was too small to use the X^2 test, the Fisher's Exact Probabilities Test was used as a test for association or independence.

RESULTS

Table 1 presents mishap experience for the aircraft under study by mishap classification (AR 95-5). Included in the table are the number of aircraft flight hours and mishap rates.

A comparison among antitorque system mishap categories was made by mishap classification to determine the effectiveness of simulated antitorque training. Table 2 portrays this information. The data reveal that *loss or impaired control* usually terminated in a precautionary or forced landing with no subsequent materiel damage or injuries. Total aircraft damage amounted to $379,240. This type of failure is primarily the emergency situation addressed by antitorque training.

The data further indicate a different trend for emergencies involving *loss of thrust* and *loss of component*. These types of antitorque failures/malfunctions resulted in greater losses both in aircraft damage and personnel injuries.

Table 3 presents results of the maneuver by type of antitorque system failure or malfunction. The data indicate *loss of component* malfunctions were handled in the least satisfactory manner, whereas *loss or impaired control* malfunctions were coped with in a generally satisfactory manner. A test for association using X^2 was calculated and a significant association was found at the .05 level of significance (X^2, 2df = 25.556). The result of the emergency maneuver appears to be associated with the type of malfunction. Association means that the chances of terminating an emergency in a satisfactory manner are affected by the type of malfunction, i.e.,

TABLE 1.—Total Mishaps for Subject Aircraft From 1 July 1972 to 30 September 1976

	MISHAP CLASSIFICATION								
Aircraft Type	Major (Total)	Major (Substantial)	Minor	Incident	Forced Landing	Precautionary Landing	Total Mishaps	Flight Hours	Mishap Rate Per 100,000 Flight Hours
OH-6	10	21	1	23	32	189	276	166,675	166
UH-1	81	66	19	387	222	4,440	5,215	3,456,810	151
AH-1/TH-1	22	25	18	156	35	859	1,115	331,319	337
OH-58	50	35	7	227	182	1,572	2,073	1,402,026	148
TOTAL	163	147	45	793	471	7,060	8,679	5,356,830	162

TABLE 2.—Frequency of Mishaps by Classification and Type of Malfunction

Type of Malfunction	Major (Total)	Major (Substantial)	Minor	Incident	Forced Landing	Precautionary Landing
Loss of components	7	14	2	1	*	*
Loss of thrust	10	1	1	10	7	4
Loss or impaired control	1	1	1	1	14	33

*Not applicable

loss of thrust, loss of component, loss or impaired control.

Table 3 further breaks the data into type of malfunction by type aircraft. The test of independence reveals that in cases of *loss of component* and *loss or impaired control* the result of the maneuver was independent of type of aircraft. In other words, the type of aircraft being flown did not affect the chances of satisfactorily terminating emergencies caused by *loss of component* or *loss or impaired control.* However, there is a significant association ($p < .05$) between type aircraft and result of the maneuver in cases of *loss of thrust.*

AH-1 aviators were more successful in their efforts to deal with a *loss of thrust* than UH-1 or OH-58 aviators. Because of the significant association found between aircraft type and result of maneuver, initial indications appeared to point toward differences in following prescribed procedures across aircraft types. In other words, could the success of AH-1 aviators in dealing with a *loss of thrust* be attributed to adherence to emergency procedures?

Data in table 4 is presented in the form of a contingency table to show adherence to procedure by type aircraft. Approximately 70 percent of the aviators involved in mishaps followed standard procedures in coping with the emergency situation. The calculated X^2 (1.052, 2df) failed to reach the critical value of 5.99 for 2df at the .05 level of significance. Adherence to procedures appears to be independent of the type aircraft flown. Independence means that aviators flying in AH-1/TH-1 type aircraft are not prone to follow procedures more than aviators flying UH-1s or OH-58s.

The procedures found in the operator's manuals for AH-1/TH-1 aircraft differ from those found in the UH-1 and OH-58 operator's manuals. The AH-1/TH-1 emergency procedure for *loss of thrust* malfunction dictates immediate autorotation. The UH-1 and OH-58 emergency procedures for the same type of malfunction recommend continued flight to a suitable landing area.

Table 5 presents accident information con-

TABLE 3.—Result of Maneuver by Type of Malfunction and Aircraft Type

Category of Malfunction Type Aircraft	Result of Maneuver Satisfactory	Unsatisfactory	Total
I. Loss of Component*			
AH-1	4	5	
UH-1	4	9	
OH-58	1	1	
Total	9	15	24
II. Loss of Thrust**			
AH-1	8	0	
UH-1	10	9	
OH-58	2	4	
Total	20	13	33
III. Loss of Control***			
AH-1	15	2	
UH-1	26	2	
OH-58	6	0	
Total	47	4	51

* Not significant $p > .05$ (Fisher's Exact Probability = .1378)
** Significant $p < .05$ (Fisher's Exact Probability = .0024)
*** Not significant $p > .05$ (X^2, 2df = .891)

TABLE 4.—Adherence to Procedures by Type Aircraft

Type Aircraft	Adhered to Procedures		
	Yes	No	Total
AH-1	21	13	34
UH-1	43	17	60
OH-58	9	5	14
TOTAL	73	35	108

Not significant p >.05 (X^2, 2df = .891)

cerning the election to continue flight or autorotate immediately when a tail rotor/antitorque malfunction occurs. Because the situations were so dissimilar, quantitative analysis is inappropriate. Data presently available in mishap reports are not amenable to statistical analysis that would indicate preferable procedures for dealing with antitorque failure.

To place the mishap experience that occurred during training for emergencies in proper perspective, a comparison was made of simulated antitorque and other simulated in-flight emergencies. Table 6 shows this comparison. As evidenced by this table, simulated antitorque training does not appear to have mishap experience disproportionate to other types of emergency training.

Mishaps that occurred during training often were not a function or aviator technique. Seven of the 20 simulated antitorque mishaps shown in table 6 did not meet evaluation criteria. Appendix C provides detailed information regarding aircraft damage and personnel injury by type aircraft. The information is further divided into mishaps occurring because of materiel malfunctions and training. Training mishaps were found to be less severe than those resulting from materiel failure/malfunction. The ratio between aircraft damage occurring in materiel failure/malfunction and training is on the order of 12:1. No fatalities and only one injury occurred due to poor technique in training for antitorque system failures/malfunctions. Total aircraft damage sustained during simulated antitorque training for the UH-1 aircraft was only $7,190. Damage to the AH-1/TH-1 aircraft was found to be the greatest source of loss during antitorque training. Actual material losses amounted to $397,398.10.

TABLE 5.—Continued Flight vs Autorotation Mishap Information

	Continued Flight	Autorotation
1. Number mishaps	12	17
2. Aircraft damage*	$2,277,302.97	$1,630,644.00
3. Mean damage per accident/incident	$227,730.30	$108,709.60
4. Injuries	29	9
5. Fatalities	5	1
6. Terrain		
a. Suitable	6	15
b. Unsuitable	6	2

*Aircraft damage does not include strikes or hits (damage always incurred). Two strikes occurred and pilot elected to continue flight. Two strikes occurred and pilot elected to autorotate. Aircraft damage does not include autorotations made to hostile terrain.

TABLE 6.—Comparative Cost of Emergency Training Mishaps
1 July 1972 to 30 September 1976

	No. Accidents/ Incidents	Damage	Injuries	Fatalities
I. Simulated antitorque				
OH-6	0	0	0	0
UH-1	5	$ 7,190.00	0	0
AH-1/TH-1	11	398,414.80	1	0
OH-58	4	458,145.00	2	0
Total	20	$863,749.80	3	0
II. Simulated engine-out (single)				
OH-6	9	$154,728.00	1	0
UH-1	51	1,554,677.00	6	2
AH-1/TH-1	21	1,042,768.00	1	0
OH-58	22	31,658.00	0	0
Total	103	$2,783,831.00	8	2
III. Simulated hydraulics-off				
OH-6	-	0	-	-
UH-1	5	$296,747.00	3	0
AH-1/TH-1	2	510,283.00	2	0
OH-58	1	398.00	0	0
Total	8	$807,428.00	5	0

DISCUSSION AND CONCLUSIONS

Training for failure/malfunction resulting in *loss or impaired control* is effective in providing the skills and confidence aviators need to cope with an actual emergency. This observation is supported by the low number of catastrophic mishaps as opposed to the high number of precautionary and forced landings this type of failure/malfunction produces.

The skills that aviators acquire during fixed-pitch antitorque training do not appear to be effective in coping with tail rotor/antitorque malfunctions involving *loss of component.* The high ratio of major accidents to minor accidents and incidents substantiates this conclusion. *Loss of component* is the most difficult for aviators to handle. Their lack of success is due not only to a loss in tail rotor antitorque effectiveness, but also to an accompanying shift in the center of gravity.

Malfunctions involving *loss of thrust* of the tail rotor/antitorque system were dealt with less effectively than *loss or impaired control.* Results do indicate that AH-1 crewmembers were more successful in coping with this type of malfunction than UH-1 or OH-58 crewmembers. This may be attributable to several variables. Among these variables, the most logical reason appears to be differences in emergency procedures for these aircraft. Emergency procedures for a *loss of thrust* in the AH-1 dictate immediate autorotation. In UH-1 and OH-58 aircraft, the emergency procedure *for this type malfunction* is to continue flight to a suitable landing area. Present mishap data is not amenable to determine the better course of action, i.e., autorotation vs. continued flight. Mishap reports do indicate that when the crew attempts to continue flight, aircraft performance can deteriorate to a point where a successful autorotation is difficult to perform. The comparatively higher number of fatalities and injuries experienced in those mishaps where the crews elected to continue flight supports this conclusion. It appears the proper

course of action in the event of *loss of thrust* or *loss of component* is highly dependent on aerodynamic characteristics of the aircraft involved and the flight profile at the time of the emergency. There has been little data generated specific to this problem. Additional information is needed to decide which of these procedures is optimum. The reason AH-1 crews coped so successfully with loss of thrust may not be because of the procedure to enter autorotation immediately. Rather, it could be that, unlike for the UH-1 and OH-58, the element of indecisiveness is removed.

Mishap costs associated with antitorque training do not appear to be inordinate when compared with training for types of emergencies. A high proportion of materiel damage and injuries that occur during simulated antitorque training are the result of making a running landing to poorly selected areas.

The AH-1 type aircraft contributed a disproportionate share of total mishap costs involving antitorque training. This can be attributed to design features such as its high center of gravity, narrow skid landing gear, and limited visibility from the aft crew station. These factors make alignment at the critical moment of touchdown difficult. Because of the design features, special consideration should be given to AH-1/TH-1 training to decrease risks, e.g., perform running landings to hard surfaces.

It should be noted that the analysis does not include operational wear and tear on the aircraft, i.e., skid shoe replacement. Neither does it include training costs, i.e., IP time, blade time, etc. It would not be possible to address the cost effectiveness of antitorque training until all these factors had been considered. Costs shown in this study represent mishap cost only. If a cost-of-training-effectiveness analysis is conducted, losses due to training mishaps should not be overlooked.

AUTHOR'S FOOTNOTE

This evaluation was completed in July 1977. The results and preliminary report were briefed to the aviation representative for Deputy Chief of Staff, Operations at that time. As a result, the message at Appendix D was transmitted to the field implementing the recommendations of this study. This is a vivid demonstration of how mishap experience may be used to provide managers with useful and realistic information upon which to make sound decisions.

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APPENDIX A
TAIL ROTOR MALFUNCTION ANALYSIS

Work Sheet

Log Number ____________

MDS

1. UH-1 (All)
2. T/AH-1 (All)
3. OH-58
4. OH-6

Cost Material Damage $ ___
Injury $ ___
Property $ ___
Total $

Classification

1. T/L
2. Maj
3. Min
4. Inc
5. F/L
6. P/L

Phase of Flight

1. Hover
2. Climb
3. Cruise
4. Descent

Condition of Flight

Airspeed ____________ Kts
0-40
41-60
61-100
Above 100

Actual A/S

Altitude ____________ AGL
1-25
26-100
101-500
Over 500
Not Reported

Actual Alt.

Weight ____________ Lbs

1. Light (below 75%)
2. Average (76-90%)
3. Heavy (91-100%)
4. Overgross (100%+)
5. Not Reported

Type of Failure

1. Loss of Components
2. Loss of Thrust
   3. (Descent) Low Power
   4. (Cruise) Cruise Power
   5. (Climb) High Power

Cause of Failure

1. Material ____________
2. FOD ____________
3. Strike ____________
4. Other ____________
5. Not Reported or Unk ___

Recognized Problem

1. In Time ____________
2. Too Late ____________
3. Not at All ____________

Responses to Failure (When Recognized)

1. Proper Procedure ____________
   1. Unknown ____________
   2. Continued Flight ___
   3. Autorotation ____________
   Throttle Manipulation
   4. Added ____________
   5. Reduced ____________

1. Improper Procedure ____________
   1. Unknown ____________
   2. Continued Flight
   3. Autorotation
   Throttle Manipulation
   4. Added
   5. Reduced

Results of Response (Initial)

1. Satisfactory ____________
2. Unsatisfactory ____________
   2. Spin Right ____________
   3. Spin Left ____________
   4. Roll Right ____________
   5 CG Shift ____________
   6. Mast Bumping ____________
   7. Roll Left ____________

Terminal Action

1. Satisfactory Autorotation
   1. Yes
   2. No
   Throttle Manipulation
   1. Added
   2. Reduced

2. Unsatisfactory Autorotation
   1. Yes
   2. No
   Throttle Manipulation
   1. Added
   2. Reduced

Terminal Terrain Suitability

1. Nonhostile (Suitable)
2. Hostile (Unsuitable)

Results of Termination (Touchdown)

1. Nothing
2. Hard
3. Rollover
4. Flipped
5. Spinning R
6. Spinning L

Results of Emergency Maneuver

1. Satisfactory
   1. Followed Standard Training Procedure
   2. Followed Nonstandard Training Procedure

2. Unsatisfactory
   1. Followed Standard Training Procedure
   2. Followed Nonstandard Training Procedure

Given this exact situation, if the pilot had followed -10 procedures exactly, what are the chances that he would have gotten the A/C down with no damage?

1. 0-19%
2. 20-39%
3. 40-59%
4. 60-79%
5. 80-99%

Given this exact situation, how helpful would antitorque training (as it is currently given) have been?

1. Extremely helpful
2. Very helpful
3. Helpful
4. Not very helpful
5. Not helpful at all

APPENDIX B

ANTITORQUE SYSTEM MISHAPS REVIEWED FOR EVALUATION

	Major (Total)	Major (Substantial)	Minor	Incident	Forced Landing	Precautionary Landing
I. Mishaps Meeting Criteria for Analysis	19	19	7	18	21	37
II. Mishaps Not Meeting Criteria for Analysis	2*	16**	11***	111***	1****	348****
III. Total Mishaps Reviewed for Analysis	21	35	18	129	22	385

* Training mishaps that occurred due to landing site and not specifically related to poor technique of emergency antitorque training.

** Mishaps were "ground strikes" that occurred during autorotation. The damage to the antitorque system was a result of the mishap rather than a cause factor.

*** Mishaps occurred during ground operations (aircraft not in flight). Mishaps also involved tail rotor strikes during flight operations but discovered later on postflight inspections. No loss or impaired control was detected.

**** Mishaps involved chip detector caution lights or defective hydraulic servos. In these cases it was adjudged that antitorque control impairment was not severe enough to warrant the need to use emergency antitorque procedures.

APPENDIX C

COMPARATIVE EXPERIENCE OF MATERIEL FAILURE/MALFUNCTION MISHAPS VS. TRAINING MISHAPS

	Total Loss	Major	Minor	Inc	F/L	P/L	Mishap Totals
I. UH-1							
#Materiel Failure Mishaps	11	9	2	5	12	21	60
Aircraft Damage	$3,533,632	$470,989	$39,986	$13,048.26	-	-	$4,057,655.26
Inj	28	3	0	0	-	-	31
Fatal	5	0	0	0	-	-	5
#Training Mishaps	0	0	0	5			5
Aircraft Damage	0	0	0	$7,190.00	-	-	$7,190.00
Inj	0	0	0	0	-	-	0
Fatal	0	0	0	0	-	-	0
II. AH-1G/TH							
#Materiel Failure Mishaps	2	5	2	4	8	12	33
Aircraft damage	$1,019,666	$526,648.75	$74,354	$17,162	-	-	$1,637,830.73
Inj	0	3	0	0	-	-	3
Fatal	1	0	0	0	-	-	1
#Training Mishaps	0	3	3	1			7
Aircraft Damage	0	$219,883.41	$173,709	$1,416.69	-	-	$397,398.10
Inj	0	1	0	0	-	-	1
Fatal	0	0	0	0	-	-	0
III. OH-58							
#Materiel Failure Mishaps	4	2	0	2	1	4	13
Aircraft Damage	$540,591	$10,501.49	0	$3,888.70	-	-	$554,981.19
Inj	7	0	0	0	-	-	7
Fatal	0	0	0	0	-	-	0
#Training Mishaps	1	0	0	0			1
Aircraft Damage	$151,565	0	0	0			$151,565
Inj	0	0	0	0			0
Fatal	0	0	0	0			0
IV. OH-6							
#Materiel Failure Mishaps	1	0	0	1	0	0	2
Aircraft Damage	$68,324.00	0	0	$1,156.00	-	-	$69,480
Inj	0	0	0	0	-	-	0
Fatal	0	0	0	0	-	-	0
#Training Mishaps	0	0	0				0
Aircraft Damage	0	0	0				0
Inj	0	0	0				0
Fatal	0	0	0				0
Subtotals							
#Materiel Failure Mishaps	18	16	4	12	21	37	108
Aircraft Damage	$5,162,213	$1,008,139.24	$114,340	$32,865.96	-	-	$6,317,558.20
Inj	35	6	0	0	-	-	41
Fatal	6	0	0	0	-	-	6
#Training Mishaps	1	3	3	6			13
Aircraft Damage	$151,565	$219,883.41	$173,709	$10,995.69	-	-	$556,153.10
Inj	0	1	0	0	-	-	1
Fatal	0	0	0	0	-	-	0
GRAND TOTAL							
#Materiel Failure/Tng Mishaps	19	19	7	18	21	37	121
Aircraft Damage	$5,313,778	$1,228,022.65	$228,049	$43,861.65	-	-	$6,873,711.30
Inj	35	7	0	0	-	-	42
Fatal	6	0	0	0	-	-	6

APPENDIX D

R 201956Z Jun 77
FM HQDA Wash DC //DAMO-RQD//
To AIG 7406
RUCLDQA/CDR USAAVNC Ft Rucker AL
RUEADWD/DA (NGB) Wash DC
BT
UNCLAS

SUBJ: Touchdown Autorotations and Simulated Tail Rotor Failure

A. DAMO-ODA 172143Z Feb 76, SUBJ: Touchdown Autorotations in TOW-Equipped Attack Helicopters.
B. CINCUSAREUR, AEGC-AV 280910Z Feb 77, SUBJ: Touchdown Autorotations in TOW-Equipped Attack Helicopters.
C. CSM, 79-95-66, 30 Dec 76, SUBJ: US Army Aviation Standardization.
1. Ref A terminated touchdown autorotations in Cobra TOW aircraft. Ref B requested to designate two Cobra TOW aircraft per unit for utilization of touchdown autorotations. Ref C tasked ODCSLOG to provide Army-wide policy pertaining to identification of aircraft for conduct of autorotations at unit level.
2. Simulated antitorque training.
A. The guidance herein is based on a study recently completed by USAAAVS which was coordinated with USAAVNC and worldwide standardization. Of the 8,679 mishaps of all classifications reported for the period 1 July 1972 - 30 September 1976, 610 were antitorque associated.
B. 121 mishaps involved degradated control of the tail rotor due to loss of component or thrust or inability to direct or control the tail rotor thrust. The criteria used in the selection of these mishaps were:
(1) Antitorque/tail rotor system malfunction/failure or training problem occurred in flight.
(2) During flight operations not involving simulated antitorque failures the crew experienced some impairment of control of tail rotor/antitorque system.
(3) Simulated antitorque training mishaps that occurred were associated with poor technique or failure to meet prescribed criteria for the maneuver.
(4) Crew did take or could have taken some action to minimize material damage, injuries, and/or fatalities.
C. 13 mishaps occurred during simulated antitorque training.
D. 489 mishaps were attributed to FOD, tree/ground strikes, etc.
E. The study, to be published and distributed at a later date, found that:
(1) Training for loss of antitorque control (stuck pedal) is effective.
(2) Training for loss of antitorque control (stuck pedal) is minimally effective in situations involving loss of component or loss of thrust.
(3) A high proportion of material damage costs and injuries that occur during simulated antitorque training are associated with performing a running landing to poorly selected training areas.
(4) AH-1 emergency procedures for loss of thrust appeared more effective than loss of thrust emergency procedures for the UH-1 and OH-58.
(5) Though inconclusive, the best course of action for loss of component and loss of thrust is to enter autorotation immediately.
F. As a result of these findings, the following actions are to be taken:

(1) Continue simulated antitorque training as outlined in TC 1-35 and TC 1-36 as a graded maneuver.

(2) Conduct simulated antitorque training in AH-1 and OH-58 aircraft to hard surfaces only. UH-1 training may be conducted to hard surfaces or other approved training areas with emphasis on good ground recon.

3. Touchdown autorotations and simulated tail rotor failures may be conducted in all model helicopters. The following special instructions apply:

A. Troop/company size units with more than ten helicopters may designate two for the purpose of conducting touchdown autorotations and simulated tail rotor failures. Units with ten or less may designate one.

B. Units equipped with AH-1 helicopters will utilize the AH-1S as long as such models are on hand.

C. Wing stores will not be loaded.

D. The number of autorotations will be logged on DA Form 2408-12 in accordance with par. 4-11 D (2), TM 38-750.

E. Block 17, DA Form 2408-13 will have the entry, "This aircraft designated for touchdown autorotations and simulated tail rotor failures." The entry will be carried forward on a daily basis and will not be transcribed to the DA Form 2408-14. No entries are necessary in blocks 7, 16 and 18 or DA Form 2408-13.

F. Additional helicopters will not be designated for touchdown autorotations and simulated tail rotor failures while the initally designated aircraft are assigned to the unit.

4. DA POC is LTC Shain, DAMO-RQD, AV 227-9666.